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(54) Title: MONITORING SYSTEM AND APPARATUS

(57) Abstract

A system for monitoring activity in e.g. a building comprises an intelligent floor having a matrix of pressure sensitive sensors, means to detect changes in state of the sensors, means to determine the position of the sensors, clock means, and means to detect changes in sensor state within time periods determined by the clock means. The invention also concerns a novel intelligent flooring material and methods of manufacture thereof.

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Monitoring system and apparatus

This invention relates to a system for monitoring activity and is particularly concerned with the detection of movement, or lack of movement, of humans. The invention also relates to intelligent flooring and materials therefore.

The monitoring of human activity has particular application in the security industry where remote sensors are required to detect intruders and shoplifters. Such monitoring also has application in cases where lack of activity is important, for example in the homes of old or infirm persons.

Known systems for monitoring activity have a high rate of false alarm and are frequently mistrusted to an extent that their benefit is questionable. Such systems often suffer from over sensitivity and may be triggered by animal movement or by vibration or wind.

Many prior detection systems, including those using infra-red, microwave, vibration sensing and ultrasonic devices, are passive in the sense that once the alarm has been triggered no further information is relayed to a monitor. Passive alarms are also frequently a cause of annoyance to neighbours and the high rate of false alarm often results in a slow investigation. Semi-active systems, such as those using video cameras, are expensive and rely on the alertness of an operator.

The present invention provides a system for monitoring

activity (or lack of activity) which overcomes these advantages and gives no false alarms.

According to the invention there is provided a monitoring system comprising an intelligent floor having a matrix of pressure sensitive sensors, means to determine the position of any one of said sensors, means to determine a change in state of any one of said sensors, clock means, and detection means to detect a change in state of any one of said sensors within a time period determined by said clock means.

Preferably the detection means a system wherein said detection means is adapted to detect a change in state of any one of said sensors in each of a plurality of time periods.

The system may further include comparison means to compare the state of any one of said sensors with the state of any other one of said sensors within a time period.

Signals from the matrix are preferably analyzed by microprocessor means linked to a visual display to allow a plan of the intelligent floor to be viewed in real time.

Such a monitoring system has the advantage over conventional detection systems that single movements within a given time period will not trigger the alarm. Thus for example a night-time intruder in a shop will generate sufficient signals to sound an alarm whereas a single item of stock falling on the floor, perhaps, by reason of vibration from a vehicle, will not trigger the alarm. The

time period may of course be varied to suit the particular application.

Prior art systems which rely on a second triggering have been proposed but these are still subject to false alarms. For example infra red sensors may be triggered by convection currents or sunlight, and doppler shift sensors may be triggered by environmental noises.

The system allows monitoring in real time from a remote location and not only alerts security staff but also permits the actual location of an intruder, point of entry and point of exit to be seen. Such information could be invaluable in apprehending the intruder. The system has the advantage of incorporating a large degree of intelligence which thus provides a computer with sufficient data to enable a complex algorithm to be employed.

It is envisaged that a number of intelligent floors could be linked by telephone line to a single security monitor. Detection of an intruder would ring a security office alarm and allow the security officer to view movements of the intruder whilst alerting the local police force. The intruder would not know that he had been detected and arrest would therefore be less likely to be violent. Furthermore the flooring could be used to trigger a video camera only when required and to cause the camera to automatically track an intruder across the floor; such a system would clearly reduce the overall cost of operating a video security system whilst reducing the dependence of such

systems on vigilant staff.

The system also allows daytime processing of information from an intelligent floor, but since the daytime traffic is much greater, the computer processing facilities and data transmission arrangements would be more complex; for example by using a number of intermediate processing terminals to sort and classify information. Daytime processing would be used, for example, to give information on activity in a particular store area or to show preferred customer routes through a store. In a particular embodiment a `substation' or node receiving data from up to 240 sensors would be linked to a central data gatherer by a cable common to all substations. Where the rate of transmission of information is a limiting factor several networked systems could be provided, each with a dedicated port at the central point.

An important aspect of the invention is that the system can be readily switched from low intensity (security) monitoring to high intensity (daytime traffic) monitoring without modification of the intelligent floor.

For example an intelligent floor module in front of a lift could provide electronic traffic information which would be used to control lift operation in the most economical manner. At non-working times the intelligent floor system would be switched to a low intensity mode for security monitoring.

In addition the system has safety benefits. For

example, in the case of a fire in a building, the intelligent floor described herein will allow firemen to locate the precise position of trapped people and people who may have collapsed in their efforts to escape. This is quite simply effected by following the movements of people within the building in the period up to arrival of the fire brigade; the information from the intelligent floor being retained in a computer memory for subsequent analysis. The system also allows movement of firemen to be tracked.

A further non-security aspect is that the intelligent floor of the invention may be used to activate heating and lighting systems, and also to activate additional security or fire detection apparatus.

An important safety aspect is the monitoring of movement in the homes of old or infirm persons. For example lack of movement within a predetermined period may activate a local alarm. If the local alarm is not de-activated within a given period the system may alert a third party to make a personal investigation. At night-time the intelligent floor can function in a security mode to detect intruders.

Another important aspect of the invention is that once installed, the flooring system is not sensitive to movement of static objects, such as furniture, since the system ignores unchanging switch states.

Furthermore should any part of the intelligent floor become damaged, perhaps by a flooring nail short circuiting

a sensor, the controlling microprocessor can be programmed to ignore the relevant switch if spurious signals result.

The system also allows non-supervised visitors to be tracked to the correct location and monitored during non-working hours, for example maintenance fitters and cleaners.

In a preferred embodiment data from a group of sensors is collated at a node, and each node periodically sends data from its sensors to a central·processing unit; typically 240 sensors may report to a single node.

Preferably the system further includes means to avoid repetitive sending of data from a node where the state of sensors reporting to that node remain unchanged. Such sensors may for example be in a conductive state due to a load imposed by a nominally stationary but moveable object such as a chair. Thus processing time is saved since nodes which have unchanged data do not report the individual state of associated sensors - such an arrangement may improve the general response time of the system or may enable a plurality of node states to be examined in a reduced time for a given computing power and likely activity on the intelligent flooring.

Preferably the matrix is arranged as a grid with each sensor thus being assigned a unique address by its co-ordinates; the number of electrical signal lines is thereby minimised.

The sensors may be in the nature of a two-position switch or some other apparatus such as a piezo-electrical

device or a variable resistance sensor. In the latter case the changed state would be determined by a pre-set threshold range.

The sensors are preferably switches having a conductive and non-conductive state; the sensors may be resiliently biased to the non-conductive state.

The invention also provides an intelligent flooring material suitable for use in the monitoring system of the invention.

Pressure sensitive mats for use in triggering burglar alarms are well-known. They usually comprise two aluminium foil layers separated by a layer of foam material with apertures therein. Each of the foil layers constitutes part of an electrical circuit which is completed when a threshold load is placed on the mat and the aluminum layers are brought into contact through one or more of the apertures. The mat is usually placed in a low quality pvc envelope for protection from moisture.

Such mats are often made from very cheap materials and are generally unreliable. The welded edge of the plastic bag usually presents an outline which can be seen through the carpet. Abrasion by the carpet and moisture from below contribute to the poor reliability record of these mats and make them generally unsuitable for large scale use. Furthermore a considerable amount of wiring is necessary if a number of these mats are linked to a single alarm system.

The present invention provides a tough and robust

intelligent flooring material which is intended to replace conventional carpet underlay and thus be undetectable from above. Relatively few electrical connections are required.

According to this aspect of the invention the intelligent flooring material may include a first layer having a plurality of electrically conductive areas adapted to series connection in one direction, a second layer overlying the first area and having a plurality of electrically conductive areas adapted for series connection in another direction, and separation means to hold the conductive areas apart in the absence of a predetermined load; the electrical path between coincident areas each including a diode.

Preferably the areas of said first layer are arranged in parallel rows, the areas of each row being connected in series; and the areas of said second layer also being arranged in parallel rows, the areas of each being connected in series, the parallel rows of said first and second layer being at right angles to one another.

Such an arrangement facilitates economical production of the flooring material as mats or in rolls and enables many of the electrical paths between adjacent conductive areas to be incorporated in the manufacturing process.

The conductive areas of the first and second layers may comprise a metallic foil which, for reasons of strength and durability may be attached to a suitable substrate such as a polyester film.

In a preferred embodiment the conductive layers may be manufactured from a metallised polyester film in which unwanted conductive areas have been removed by an etching agent. Alternatively the conductive areas may be printed on a suitable substrate using conductive ink.

The separation means between the conductive areas are preferably resilient and may comprise a synthetic elastomer having apertures therein. Preferred separation means include netting of silicone rubber, where a relatively substantial degree of movement between the layers is permitted, or a layer of perforated polyester where minimal movement is allowed, or where the degree of flooring resilience is accommodated by outer layers of the laminate.

The separation means may comprise a matrix of adhesive material such as a synthetic adhesive laid onto one conductive layer and having sufficient resilience to hold the conductive layers apart against less than the predetermined contact load. The adhesive has the additional advantages of holding the conductive layers against relative movement, and providing a moisture barrier between adjacent cells in the laminate.

The material may include a layer of crumb rubber on one or both sides of the laminate to simulate standard flooring underlay.

The laminate is preferably enclosed in a protective envelope of, for example, polyethylene reinforced by polyester webbing to improve handling and durability, and

provide protection against piercing loads.

The invention also includes a method of manufacturing the conductive layers by etching unwanted areas from a metallised film by the use of a caustic solution. As an alternative the conductive areas could be printed using electrically conductive ink as aforesaid.

The method of manufacturing may include the step of applying a matrix of adhesive to one conductive face, applying the other conductive face to the adhesive and curing the adhesive to provide a strong stable laminate.

The flooring material is preferably laid on a floor on á layer of release adhesive, such adhesive is cohesive in that it retains the flooring material against movement but allows the material to be peeled from the floor for re-positioning or repairs. A second layer of release adhesive may be applied to the outer layer of the flooring material to grip an outer layer of flooring material such as carpet or vinyl tiles.

Where the flooring material is laid in strips from rolls of laminate, transverse bridge connectors may be provided to give electrical continuity transverse to the direction of laying. Such connectors may include the necessary diodes, or the diodes may be incorporated in the laminate.

The bridge connectors preferably have metallic tracks which are more flexible than the substrate on which they are carried. The diodes may be individual electrical components

or may be a varistor compound provided between respective electrical paths.

Other aspects of the invention will be apparent from the following description of several preferred embodiments shown by way of example only in the accompanying drawings in which:-

Fig 1 is a diagrammatic representation of a switch network provided by the invention;

Fig 2 is a section through a multi-layer intelligent flooring material according to a first embodiment of the invention;

Fig 3 is a perspective view of part of a non-conductive layer for the material of Fig 2;

Fig 4 is a simplified plan view of one foil layer for the material of Fig 2;

Fig 5 is a simplified plan view of the other foil layer for the material of Fig 2;

Fig 6 is an enlarged plan view of part of the foil layer shown in Fig 5;

Fig 7 is a partial view of a specific area of the foil layer in Fig 5;

Fig 8 is a simplified plan view of an inter-mat connector;

Fig 9 is a simplified plan view of an alternative form of the connector in Fig 8;

Fig 10 is a simplified plan view of a series of edge connectors, showing the pick-up of signal lines by

ribbon cable;

Fig 11 is a simplified plan view of the area covered by one substation, showing the positioning of signal lines and multiple sensing element modules.

In its simplest aspect the invention comprises a matrix of switches as illustrated in Fig 1. The X and Y co-ordinates represent electrical signal lines and at the intersection of each is placed a two state switch. A given load on any particular switch will change its state and this change can be detected by a microprocessor continuously scanning the matrix. Clock means may be programmed in any conventional manner to check for several changes of switch state within a given area and a given time.

The information may be viewed in real time and stored for later recall or analysis.

The layers of a suitable intelligent flooring material are shown in Fig 2; this material is intended for use as an underlay for carpet or the like. Seven layers A-G are shown (not to scale), but more or less layers may be provided depending on the manufacturing process and application.

For ease of handling and manufacture it is convenient to make the intelligent flooring material as standard area laminated mats to be linked together in use in a modular construction. Alternatively the material may be provided in roll form as will be further described.

In the particular construction shown, layer A is part of the "envelope" (the top part of which is layer G) which

shields the construction from moisture ingress. It is made from for example a laminate of polypropylene webbing and polyethylene film, which additionally improves handling properties and improves durability.

Layer B is a compressible material, of for example 3mm crumb foam underlay. It is intended to smooth out discontinuities in the floor surface and thereby prevent unintended changes of switch state. However as will be apparent such switching will not cause the system to malfunction. Layer F is identical in construction and gives added protection to electrically conductive layers now described.

Layer C comprises an electrically conductive layer 24, of for example aluminium foil, and having a backing 23 of for example polyester to increase strength and improve handling properties; layer E is identical in construction although the conductive layer has a different appearance as will become apparent.

As an alternative to aluminium foil, the conductive layer could be composed of some other material such as a metallised polyester film.

The conductive layers 24,26 face each other and are separated by layer D of a compressible material, such as high quality silicone rubber, and having a matrix of apertures therein as shown in Fig 3. Alternatively a film material such as polyester may be used as will be further described. This layer 25 serves to keep the foil layers

24,26 apart unless the flooring material is subjected to a local load which exceeds a predetermined level. The size, shape and spacing of the apertures, and the thickness and density of the rubber material determine the loading threshold necessary to bring the conductive faces into contact.

Layer D may alternatively be laid on to one of the conductive surfaces as an adhesive matrix and which has sufficient thickness and resilience to keep the conductive layers apart in intended use. The adhesive performs the additional role of fixing layers C and E against relative lateral movement thus giving improved resistance to abrasion damage. A further advantage of this arrangement is that the adhesive provides a seal against the ingress and migration of moisture within the laminate so improving reliability and reducing the possible incidence of switch malfunction.

Layer F is a compressible layer identical to layer B, and shielding the core membrane from point loads, by distributing them.

The compressible layers of the laminate are chosen to give the laminate the same resilience as the flooring material which it is intended to replace. Spaces between and around the intelligent flooring material may be filled with conventional underlay material of the same thickness and resilience.

Upper layer G provides additional protection and may be for example a laminate of polypropylene webbing and

polyethylene tough enough to withstand very high piercing loads from such as stiletto heels.

Where the conductive layers are a metallised film, the particular pattern of conductive areas and tracks may be achieved by a printing process using an etching agent such as caustic soda to remove unwanted conductive area, or by a kiss cutting processing in which breaks in the conductive coating separate the areas and tracks, or by an abrasion process whereby the unwanted conductive area is removed.

Etching is most suitable for thin metallised film whereas kiss cutting and skiving of unwanted material is more suitable for thicker films.

Layers C and E are now described in greater detail with reference to Figs 4 and 5. The layers could be interchanged so that layer E is the lower layer.

Fig 4 shows a backing material 23, for example a polyester sheet, on which four conductive panels 24A-24D, of for example aluminium foil are mounted by any convenient method. The precise number and arrangement of panels is not important except that in this layer the panels run continuously in one direction across the backing material. In practice the panels could cover virtually the entire area of the backing sheet and margins would consequently be minimal.

Each panel forms part of an electrical circuit indicated by the lines 31 & 32; electrical connectors are provided at opposite panel edges.

The type and size of the connectors are not important except that they obviously should not be apparent to sight or touch once the outer flooring layer is in place. The preferred connector is a flexible bridge connector buried in the laminate as will be further described.

In use eight such panels would be provided in each mat and the mats would be linked as will be described to provide continuous electrical paths in one direction, corresponding for example to the X direction of Fig 1.

The layer of Fig 5 comprises a backing sheet 27 having a plurality of conductive panels 26A-26H secured thereto in groups as shown. The panels 26 are linked to constitute the electrical paths in the Y direction of Fig 1. Again the precise size and arrangement of the panels is not important except that the individual panels must overlie a corresponding panel of the other conductive layer. In this arrangement panel 24C is coincident with panels 26A-D and panel 24D is coincident with panels 26E-H; both panels being shown face up in the drawings.

The electrical paths terminate in groups 33,34 on opposite panel edges; continuous electrical paths are provided across each group in addition to an electrical path to each panel.

The panels of Fig 5 are linked together to provide electrical paths in the Y direction.

Fig 6 illustrates that each panel in the layer of Fig 5 is connected through a diode to the electrical signal

lines 35A-35D; the diode eliminates the well-known `ghost key' effect common to all keyboard like arrangements which causes a key to appear to be depressed when a certain combination of other keys is depressed.

The position of the diodes is shown in Fig 6 for illustration only; in practice the diodes are surface mounted and preferably incorporated within the edge connectors between terminal groups 33,34.

The conductive panels 26 may be stamped from aluminium foil material in the manner illustrated in Fig 7 where integral aluminium tracks connect each panel to a terminal group in which is mounted a respective diode for connection of the panel to signal lines which run from one side of the mat to the other. The panels in layer C may be manufactured in a similar way.

The diodes of layer E are schematically illustrated in pairs and provide an electrical path between signal lines 35 and each individual panel. Flexible bridge connectors may be provided between adjacent groups of connectors 33,34 to provide a continuous electrical path across the flooring material. Alternatively the diodes may be provided in a connector 36 and such an arrangement is illustrated in Fig 8.

Dark lines show the conductive paths connecting each panel 26 to a diode, which may be of surface mount type, placed at each point where the lines approach. Diodes connecting tracks from the left-hand side provide isolation

for switches 26A-26D of the mat to the left, and diodes connecting tracks from the right hand tracks provide similar isolation for switches 26E - 26H on the mat to the right. The particular construction shown is one suitable example.

As an alternative the diodes could be printed using a varistor compound with a particular mixture of carbides and oxides to match the specific forward voltage and current requirements. A connector employing this method is illustrated in Fig 9, where the shaded area is the varistor compound.

Filters to reduce radio frequency interference and give immunity from induced electrical signals may be incorporated into the edge connectors in a similar way, using a printed dielectric in place of the varistor compound.

The layers of the flooring material are secured together by adhesive around the edge to provide a hermetically sealed enclosure for the conductive layers C and E. Adhesive is preferred because welding may give a noticeable difference in edge profile; however any method which gives a hermetic seal without affecting the compressibility of the material would be suitable - the intention being to avoid a 'hard' edge which might be felt through the outer flooring layer.

As previously mentioned layers C, D and E may be secured together by an adhesive membrane which constitutes layer D or by an adhesive material placed on either side of

layer D. This core layer (C, D and E) may be assembled using individual layers supplied from reels using for example a combination of heat and pressure.

The intelligent flooring system would use a number of modular mats each of say 1370 mm x 2740 mm and having eight panels 24 of less than 600 mm x 600 mm. Non-active material of precisely the same feel and thickness would be cut to fit around the edges of the modular unit to give wall to wall underlay on which conventional outer flooring such as carpet could be placed. Smaller or large active panels could be provided as required.

For convenience in installation, these mats may be supplied in roll form, suitable for laying out in strips and being cut to size. In one form, there is only a need to connect panels in the X-direction with inter-mat connectors during the installation, as panels in the Y-direction are connected in the manufacturing process.

The construction described is suitable for installing under, say contract carpeting, replacing conventional underlay. However, a thinner construction, suitable for installation under flooring tiles or vinyl flooring comprises the "core membrane" (layers C, D and E) and protective layers A and G, i.e. layers B and F are absent.

The electrical paths from the X and Y matrix are connected at the edge to 'edge connectors' (Fig 10), which may incorporate the printed filters mentioned above.

Ribbon cables pick up the signal lines (Fig 10) in the

X and Y direction from the edge connectors and connect them to a substation.

Fig 11 illustrates a schematic floor plan showing individual sensing modules connected by signal lines to a processing unit.

The electrical paths are connected to a microprocessor which for example scans each of the X co-ordinates for a single Y co-ordinate and then increase the Y co-ordinate incrementally and repeats the scan. In this way the state of each `switch' (corresponding to each panel 26) can be determined and thus, a real time display of activity on the intelligent floor is possible.

Special precautions may be taken to counter radio frequency interference and give immunity. This includes repeated scans in software for verification, and filters on all inputs and outputs on the substation, to slow down the signal edge and filter noise.

It has been described how the X and Y lines are picked up from two sides of the matrix. Given that the Y lines are designated the signal outputs, a single input line can be connected to each of the Y lines with diodes for isolation, at the opposite side of the matrix. This line provides verification of signal continuity, i.e. that each Y-line is intact, and thus incorporates a self-diagnostic feature.

An alternative modification is to connect the Y lines to both sides of the matrix, i.e. opposite to each other. This gives a level of redundancy, in that if a single break

occurs along any one Y-line, signal continuity is unaffected.

The required transmission speed will depend on the use to which the intelligent floor is put. For an intruder detection system the speed can be quite slow since only occasional changes in state need to be transmitted. For a system intended to analyze people-flow using data collected in real time, the amount of data to be transmitted will be very considerable and corresponding large processing facilities will be required. These data handling requirements can be met by conventional apparatus.

The upper most layer of each mat, layer G, may be printed with installation information and arrows for orientation of adjacent mats.

Operating voltage for the system is below 30v and current consumption in the region of 100mA to minimise possible oxidisation of the conductive layers. Much lower operating voltages may be suitable in small installations.

The dielectric layer D would determine the threshold load sufficient to activate the switch constituted by each panel 26. By adjusting the thickness and compressibility, and the size, shape and spacing of the apertures therein, the performance characteristics of the material will be altered. Different characteristics will be required for example for a carpet and a relatively hard vinyl floor, the vinyl spreading the load and thereby transmitting a much larger footprint. Normally the threshold level would detect

a small adult human and thereby be unaffected by cats or dogs in a domestic environment.

The conductive layers may be of any conductive material such as metal foil, but aluminum is preferred because of its cheapness and availability.

Although this aspect of the invention has been described in relation to a flooring material it may be used as an anti-theft mat on which retail items can be placed. Removal of a single item would trigger a local alarm enabling staff to locate and apprehend the thief.

The intelligent floor could also be used as a guidance device for the blind, or for normally sighted in darkness by linking the sensors to light sources or sound generators.

The invention has been described in relation to an indoor installation but is equally applicable to outdoor use so long as adequate weather protection is provided for the pressure sensors.

CLAIMS:

1. A monitoring system comprising an intelligent floor having a matrix of pressure sensitive sensors, means to determine the position of any one of said sensors, means to determine a change in state of any one of said sensors, clock means, and detection means to detect a change in state of any one of said sensors within a time period determined by said clock means.

2. A system according to claim 1 wherein said detection means is adapted to detect a change in state of any one of said sensors in each of a plurality of time periods.

3. A system according to claim 2 wherein said time periods are sequential.

4. A system according to any preceding claim and further including a microprocessor adapted to determine the state of a plurality of said sensors within a time period, and display means for displaying a real time image of said matrix.

5. A system according to any preceding claim and further including comparison means to compare the state of any one of said sensors with the state of any other one of said sensors within a time period.

6. A system according to any preceding claim and further including a plurality of nodes each to collage data from a plurality of sensors, and means to cause nodes with unchanging sensor states to be interrogated less frequently than nodes with changing sensor states.

7. A system according to any preceding claim wherein said matrix comprises a grid having sensors located at the intersections of the grid lines.

8. A system according to claim 7 wherein the sensors each comprise a switch having conductive and non-conductive states.

9. A system according to claim 8 wherein the sensors change state at a predetermined threshold load.

10. A system according to Claim 9 wherein the sensors are resiliently biased to the non-conductive state.

11. An intelligent flooring material including a first layer having a plurality of electrically conductive areas adapted for series connection in one direction, a second layer overlying the first area and having a plurality of electrically conductive areas adapted for series connection in another direction, and separation means to hold the conductive areas apart in the absence of a predetermined load; the electrical path between coincident areas each including a diode.

12. A material according to Claim 11 wherein the areas of said first layer are arranged in parallel rows, the areas of each row being connection in series; and the areas of said second layer also being arranged in parallel rows, the areas of each being connected in series, the parallel rows of said first and second layer being at right angles to one another.

13. A material according to claim 11 or claim 12 wherein the areas of said first and second layers comprise a

metallic foil.

14. A material according to claim 11 or claim 12 wherein the first and second layers comprise a metallised polyester film.

15. A material according to any of claims 11-14 wherein the separation means is resiliently deformable.

16. A material according to claim 15 wherein the separation means comprises a synthetic elastomer having a plurality of apertures therein.

17. A material according to claim 16 wherein the separation means comprises netting of silicone rubber.

18. A material according to any of claims 15-17 wherein the separation means adheres to said first and second layers.

19. A material according to claim 18 wherein the separation means comprises a matrix of adhesive material defining a plurality of apertures therein.

20. A material according to any of claims 11-19 and further including a layer of crumb rubber on at least one side thereof.

21. A material according to any of claims 11-20 and further including an outer protective envelope of synthetic plastics.

22. A material according to claim 21 wherein said envelope is a laminate of polypropylene webbing and polyethylene.

23. A method of manufacturing an electrically conductive layer for use in the material of claim 14 and comprising the steps of:

providing a polyester film having a metallic coating thereon;

printing a caustic material on said coating to define conductive areas and conductive tracks; and

activating said caustic material to remove the part of said coating in contact with said caustic material.

24. A method of manufacturing a flooring material according to claim 19 and comprising the steps of:

providing said first layer having electrically conductive areas defined thereon;

applying a matrix of adhesive to the conductive side of said layer;

applying said second layer having electrically conductive areas face down on said matrix; and curing said adhesive.

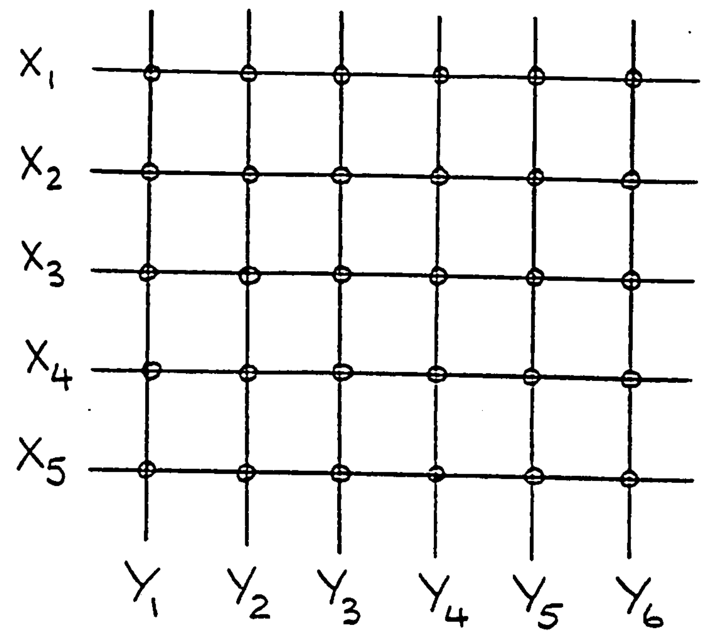


FIG. 1

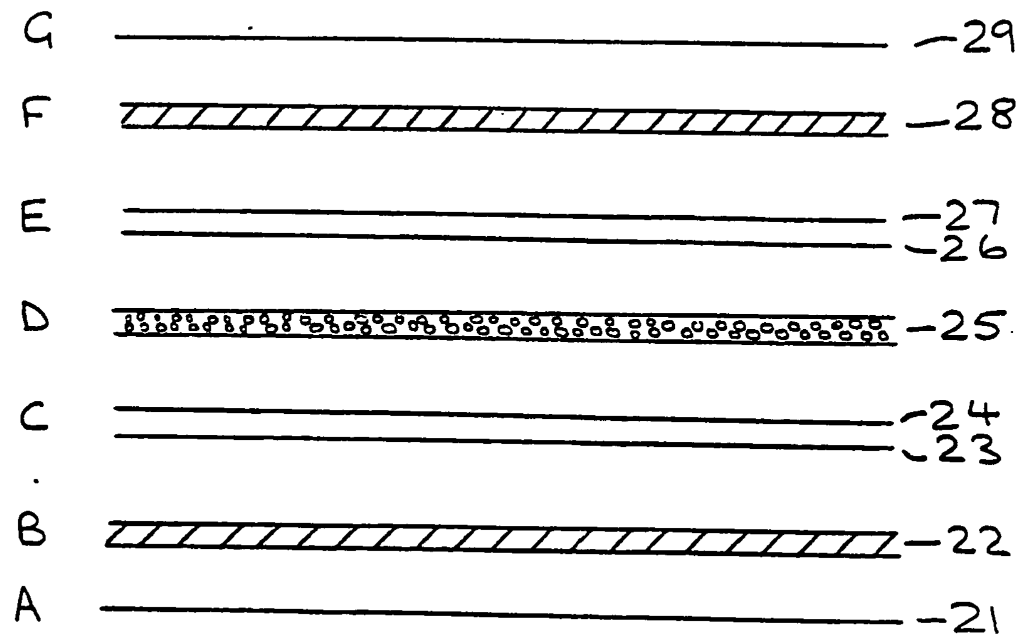


FIG. 2

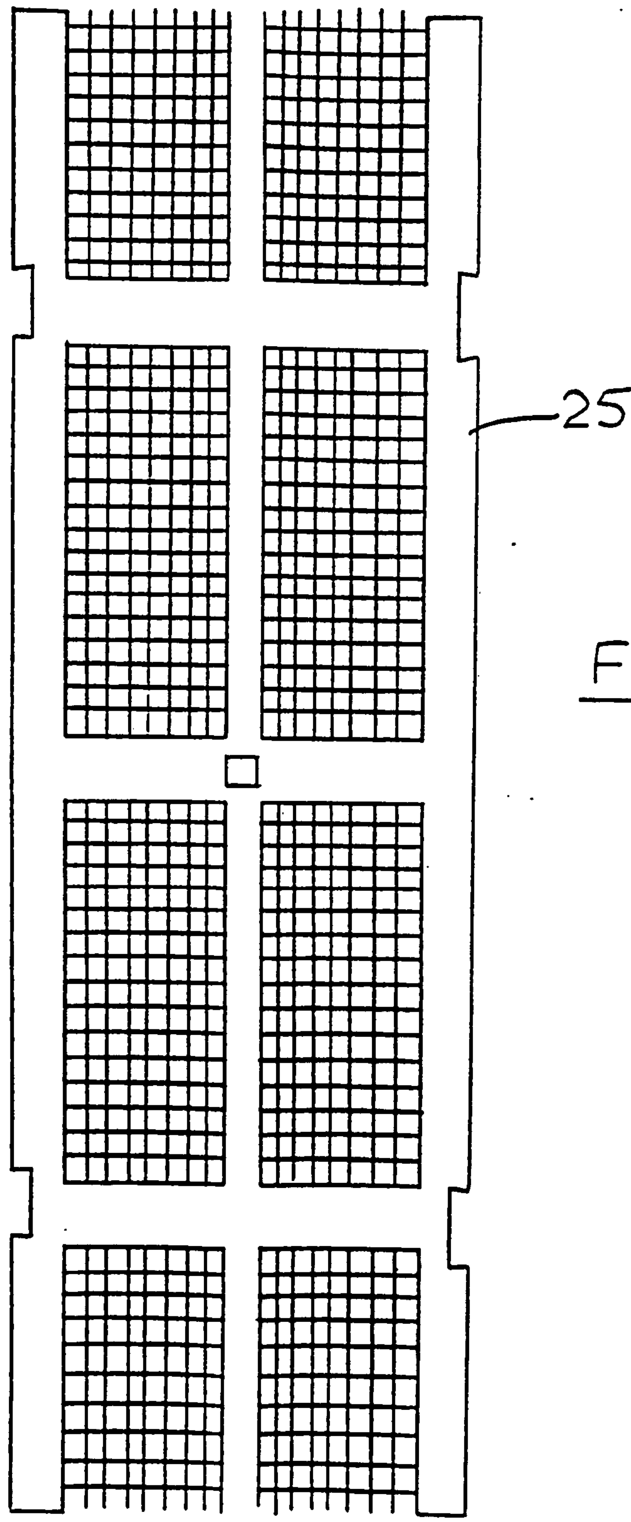


FIG.3

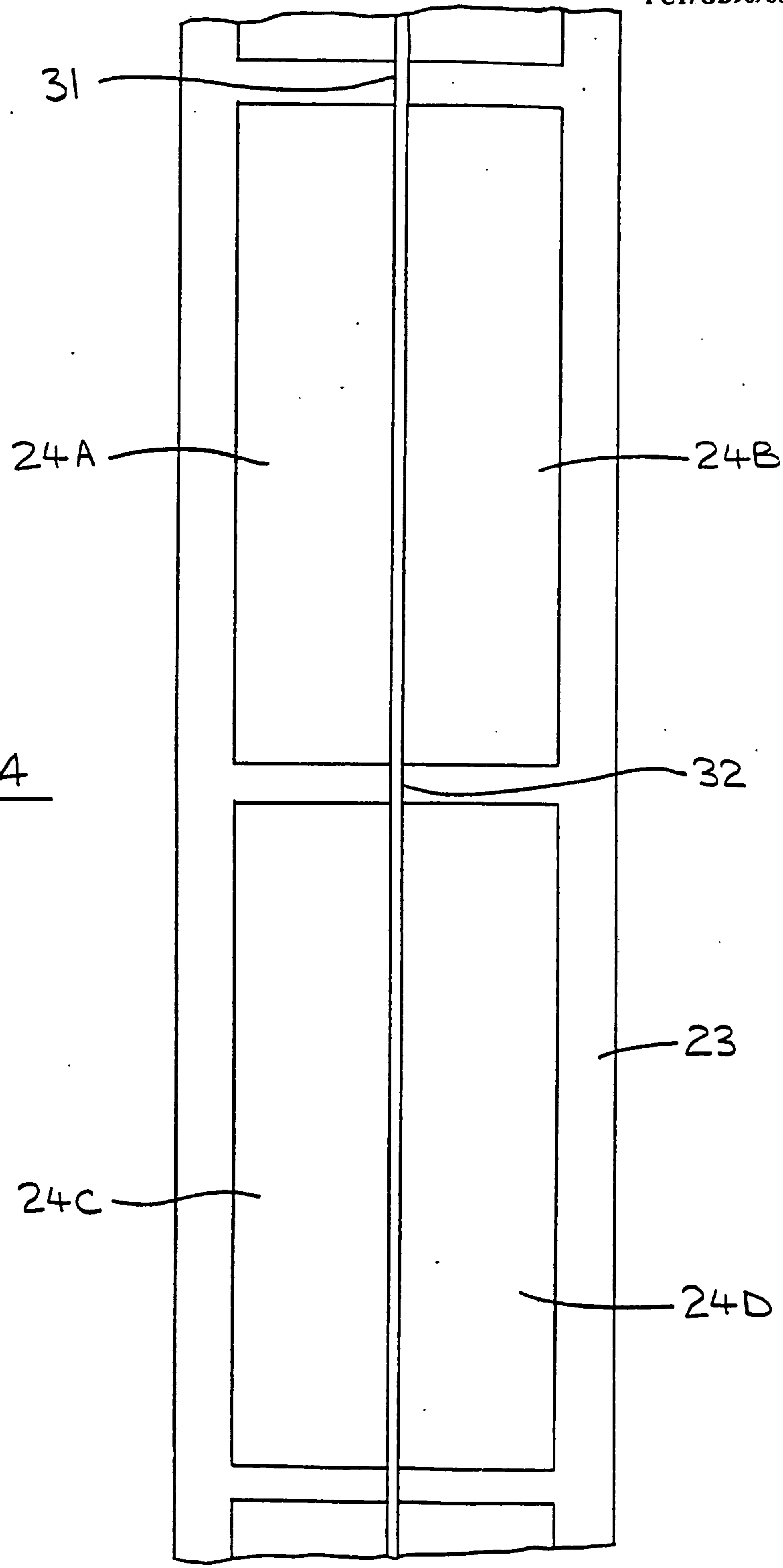


FIG 4

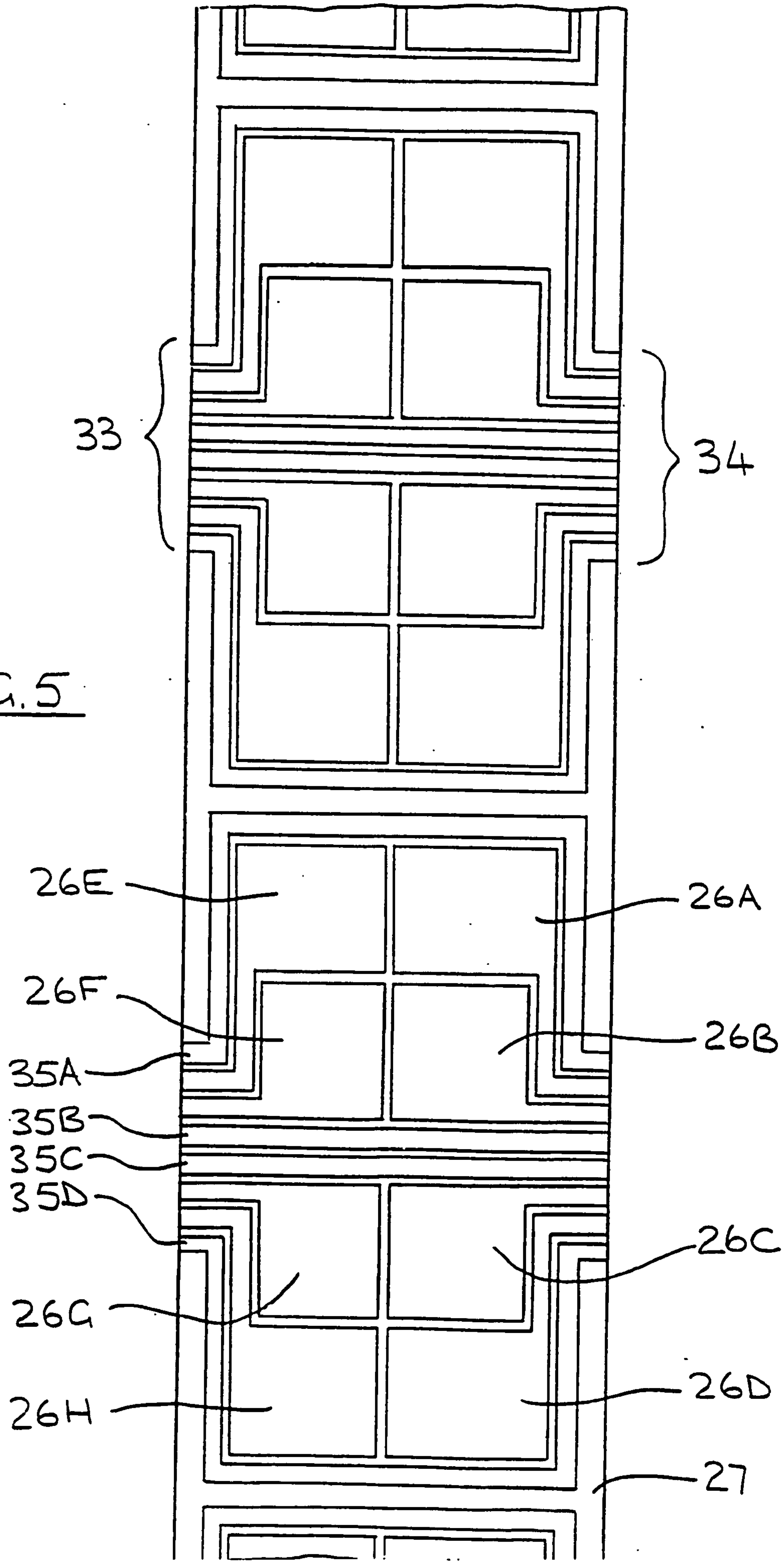


FIG. 5

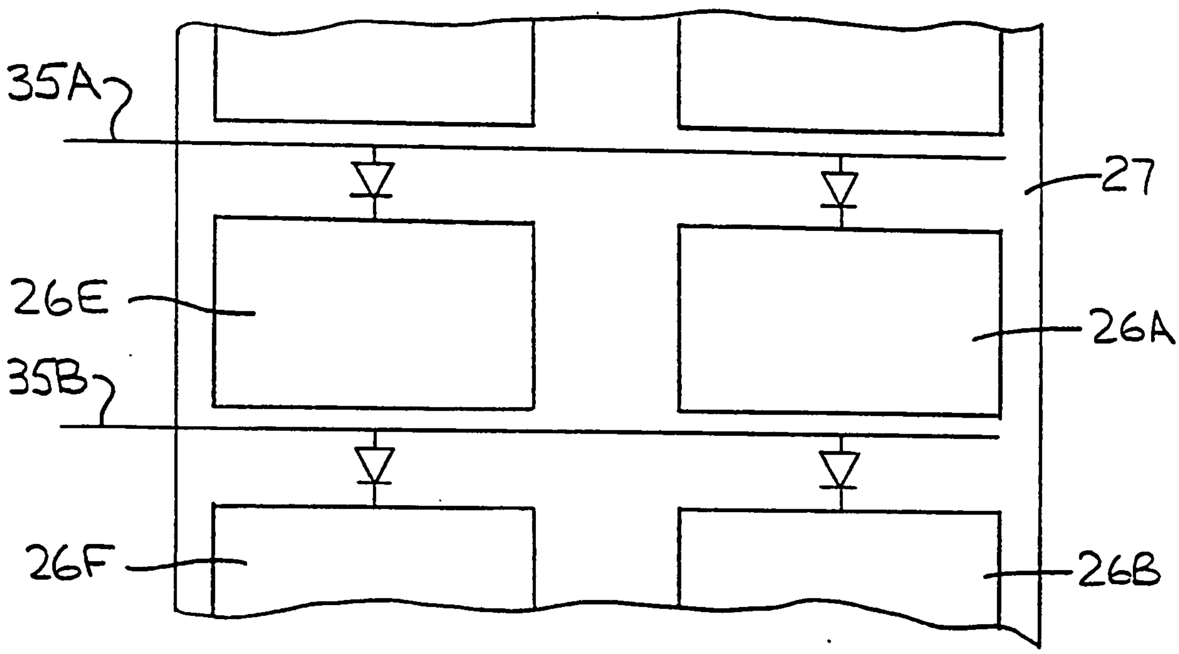


FIG 6

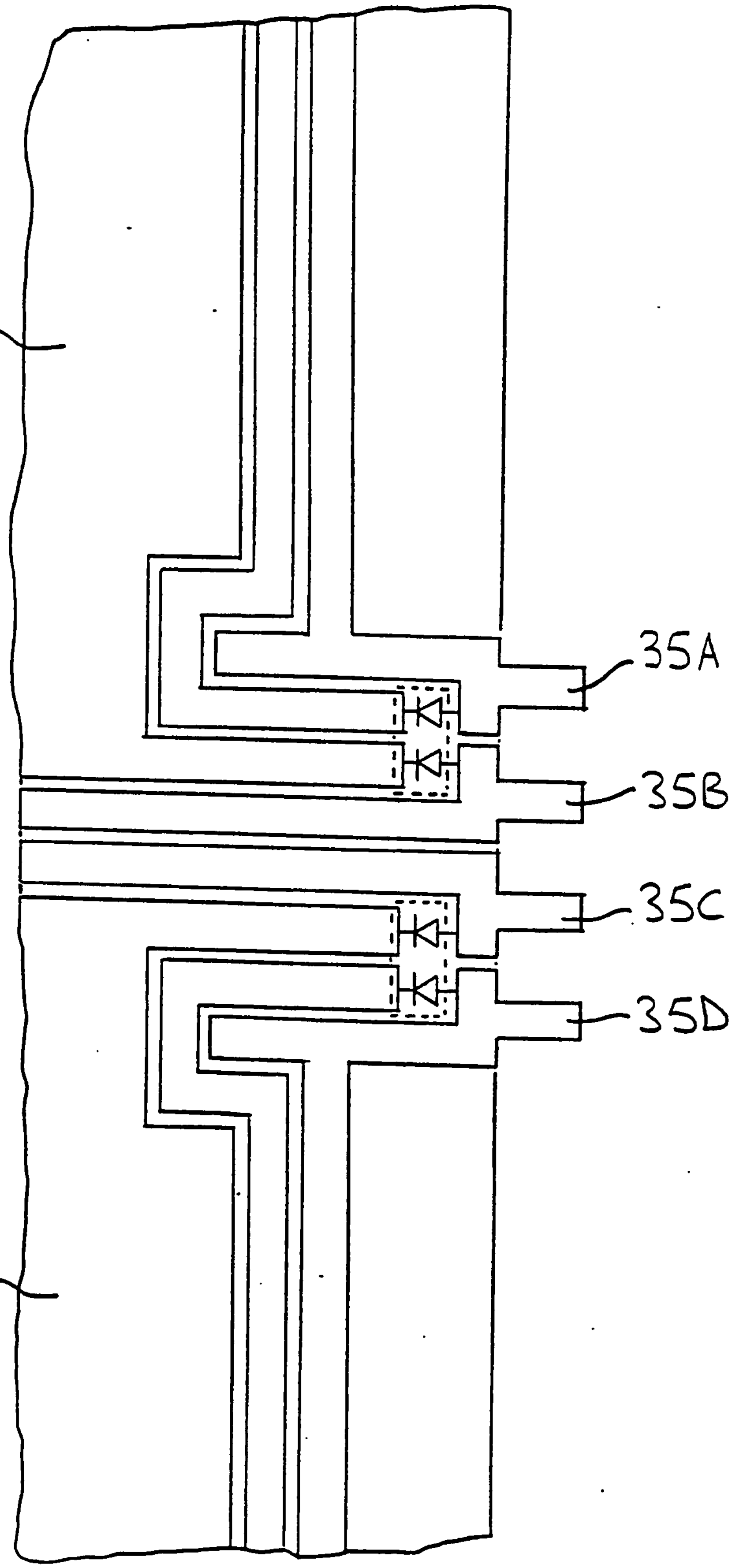


FIG. 7

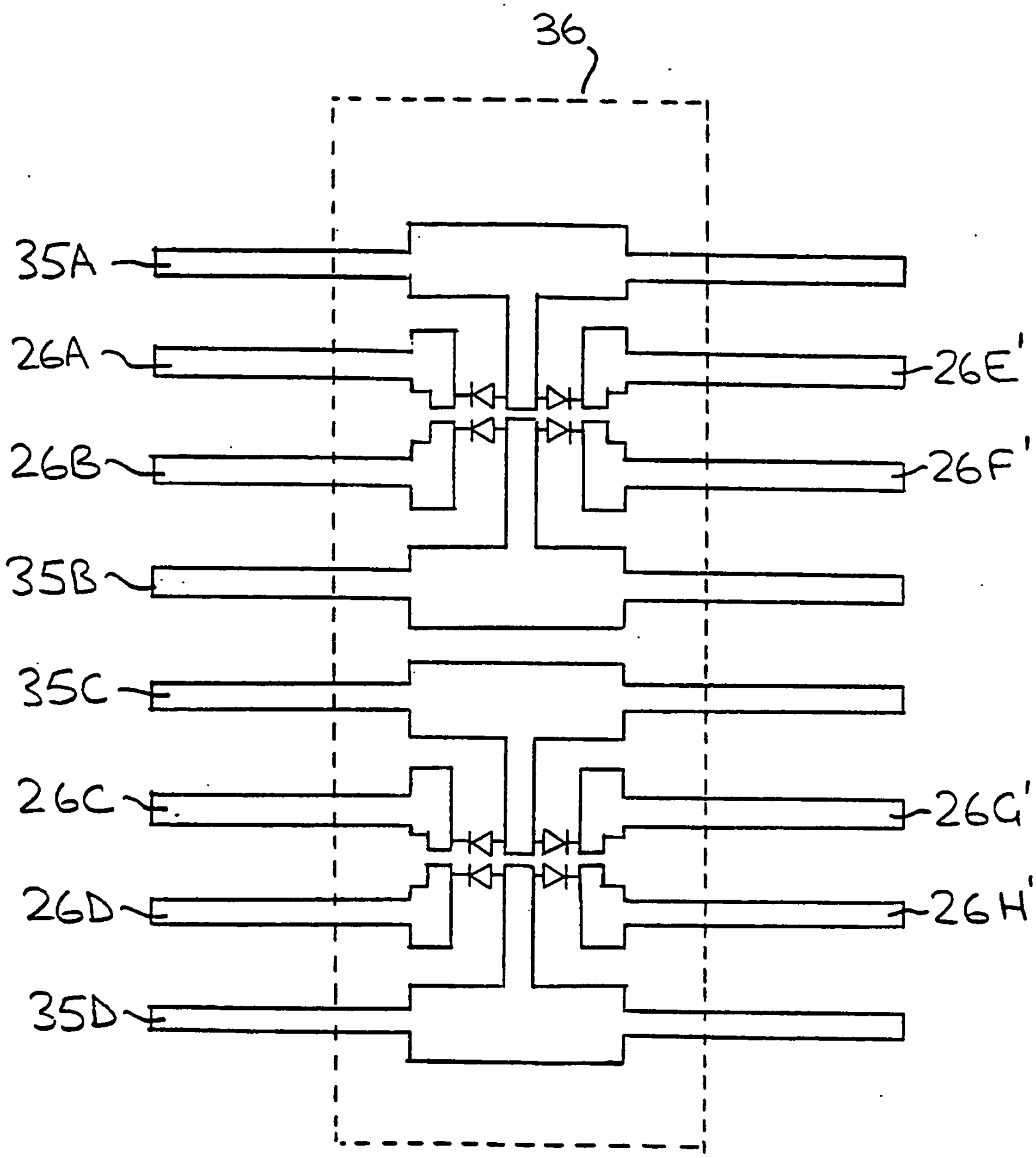


FIG. 8

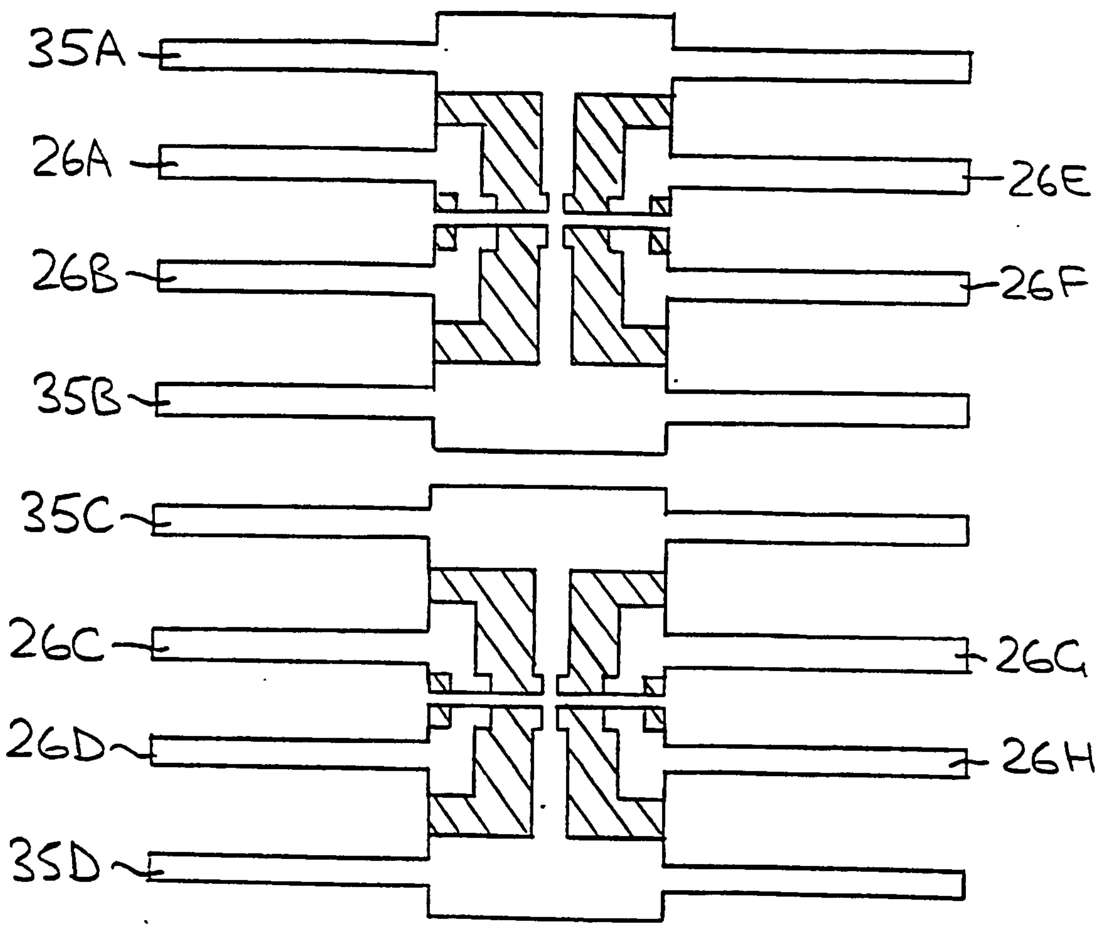
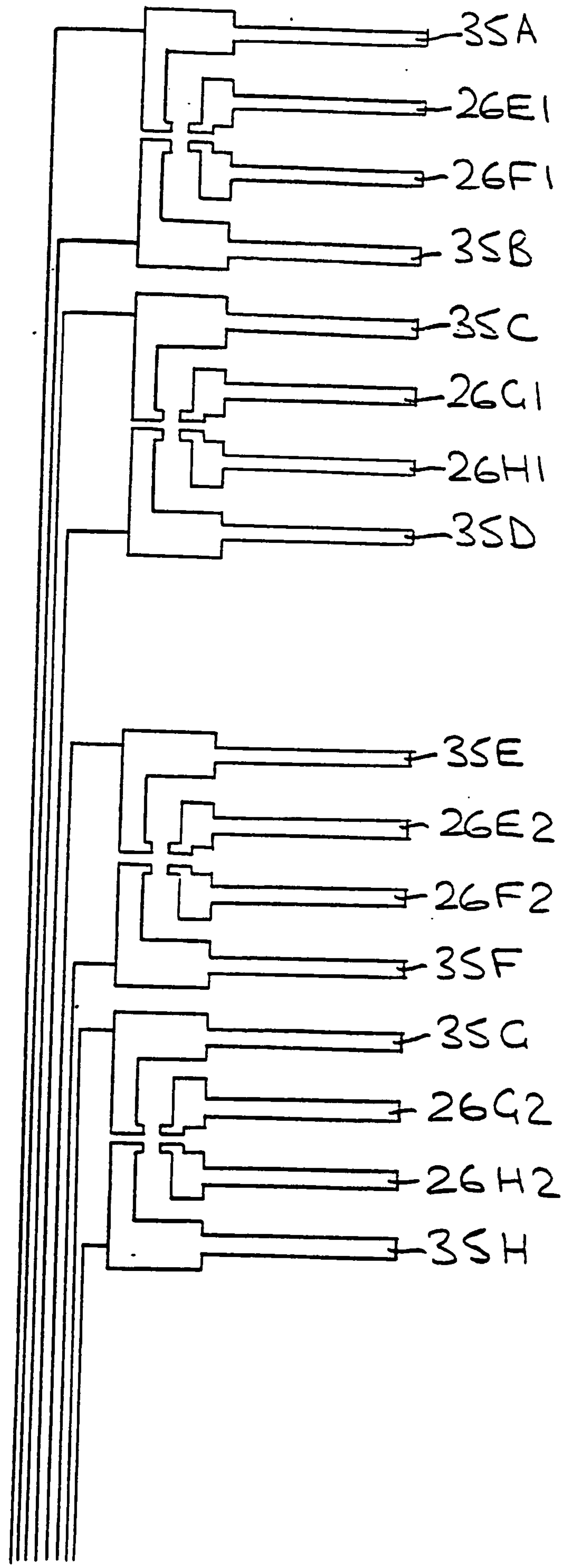


FIG.9


35A
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26F1
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35C
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26H1
35D
35E
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35F
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26H2
35H

FIG 10

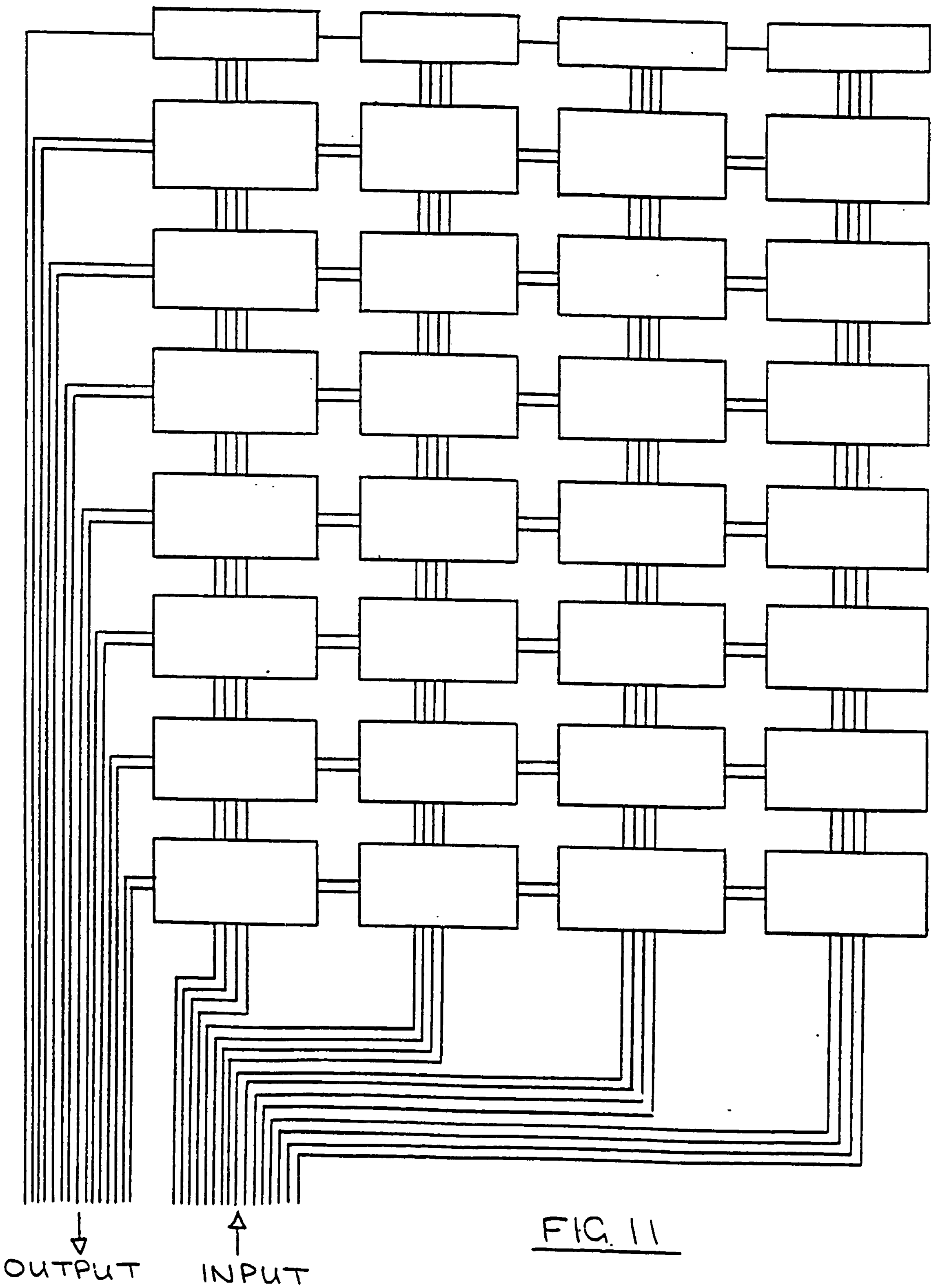

FIG. 11

INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 90/00367

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC[5]: G 08 B 13/10

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols
IPC[5]	G 08 B

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	DE, A, 3212618 (SIEMENS) 13 October 1983 see page 8, line 31 - page 9, line 25; page 11, line 14 - page 13, line 15; figures 2,6 --	1-4,11-15
A	EP, A1, 0107012 (SIEMENS) 2 May 1984 see page 6, line 20 - page 7, line 3; figure 3 --	1,11
A	DE, A, 3248222 (SIEMENS) 28 June 1984 see the abstract ----------	1,11

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
7th June 1990	03. 07. 90
International Searching Authority	**Signature of Authorized Officer**
EUROPEAN PATENT OFFICE	M. Peis M. PEIS

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON INTERNATIONAL PATENT APPLICATION NO. GB 9000367

SA 35158

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 21/06/90
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 3212618	13-10-83	DE-A- 3247278 DE-A- 3248222	28-06-84 28-06-84
EP-A- 0107012	02-05-84	DE-A- 3236056	29-03-84
DE-A- 3248222	28-06-84	DE-A- 3212618 DE-A- 3247278	13-10-83 28-06-84